

STUDY ON INTERCROPPING CARROT WITH GROUNDNUT UNDER DIFFERENT ROW ARRANGEMENTS

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Abstract

An experiment was conducted at Agricultural Research Station of BARI, Burirhat, Rangpur during two consecutive seasons of 2004-05 and 2005-06, respectively, to find out suitable row arrangement of carrot with groundnut for higher yield and economic return. There were six treatments, such as sole groundnut, sole carrot, one row of carrot in between two normal rows of groundnut, two rows of carrot in between two normal rows of groundnut, two rows of groundnut alternated with two rows of carrot and three rows of groundnut alternated with three rows of carrot. Results showed that monoculture produced the highest yields of individual crops but in intercropping system the highest groundnut equivalent yield (10.63 t/ha and 11.10 t/ha) was obtained from two rows of carrot in between two rows of groundnut. The maximum land equivalent ratio (1.67 and 1.74), the highest gross return (Tk.212600/ha and Tk. 248400/ha) and net return (Tk.184881/ha and Tk.211680) were also obtained from the intercropping treatment with two rows carrot in between two normal rows of groundnut. But due to higher cost in this treatment, maximum benefit cost ratio (7.09 and 7.01) was obtained from the intercropping treatment with one row carrot in between two normal rows of groundnut in both the years.

Keyword: Intercropping, groundnut, carrot, yield and economic return.

Introduction

Intercropping is a traditional method of crop production and recognized as a potentially beneficial system of crop production. It increases total production in addition to stabilization of production in the rainfed areas (Rao and Willey, 1980). Intercropping provides an opportunity to avoid crop competition and advantages of increased production (Rahman, 1999 and Mondal *et al.*, 1999) and greater profit margin (Evans, 1960; Grimes, 1963) and gives higher resource use efficiency (Hashem and Moniruzzaman, 1986). Rearrangement of rows, spacing and plant population are some of the important techniques that help to increase the yield of intercrop. By adopting appropriate standard planting geometry in the intercropping system, the total productivity can be enhanced (Umrani *et al.*, 1984). Groundnut is an important oilseed crop of Bangladesh and it is sown in sandy loam soil during November to December in the river banks after receding flood water. The rate of seed germination and seedling growth are very slow due

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to prevailing low temperature and it continues up to February. The plant growth becomes rapid with the increase of temperature. The space between two rows of groundnut at early stage may be utilized by planting any short stature crop as intercrop. Intercropping system gives higher cash return, increased total production and per unit yield than growing sole crop (Kurata, 1966).

Carrot (*Daucus carota* L.) is an important vegetable crop, which contains high carotene. In Bangladesh, carrot is usually sown in the month of November and December in sandy loam type of soil. It is a short duration crop; which can be grown as intercrop with groundnut. Both groundnut and carrot are row seeded crops and it is grown in the same season. Carrot can be cultivated as intercrop by utilizing space between two rows of groundnut. So, an experiment was undertaken to find out the suitable row arrangement for intercropping groundnut with carrot for higher yield and economic return.

Materials and Method

An experiment was conducted at Agricultural Research Station, BARI, Burirhat, Rangpur during *rabi* seasons of 2004-05 and 2005-06, respectively. The experimental area was a piece of well drained medium high land with moderately even topography. The area belongs to Tista Floodplain (AEZ-3), having low organic matter (1.23%) and deficient in nitrogen (0.068 $\text{NH}_4\text{-N}$ ($\mu\text{g/g}$), phosphorus (12.5 $\mu\text{g/g}$) and Ca (1.5 Meq/100 g) in comparison with the standard nutrient status. The soil is acidic in nature having P^{H} 4.6 with low O.M(1.21-1.25%) content.

Experiments were conducted in the field of ARS Burirhat, Rangpur during *rabi* seasons of 2004-05 and 2005-06. Treatments were included - T_1 = Sole groundnut, T_2 = Sole carrot, T_3 = One row of carrot in between two normal rows of groundnut (2G : 1C), T_4 = Two rows of carrot in between two normal rows of groundnut (2G : 2C), T_5 = Two rows of groundnut alternated with two rows of carrot (2G : 2C) and T_6 = Three rows of groundnut alternated with two rows of carrot (3G : 3C).

The experiment was laid out in a randomized complete block design with three replications having plot size 3m x 4m. Fertilizers were applied at the rate of 30, 100, 30, 30, and 4 kg/ha of N, P_2O_5 , K_2O , S, and Zn, respectively, for groundnut (Sole) and 50, 25, 40, and 10 kg/ha of N, P_2O_5 , K_2O and S, respectively, for carrot (Sole); and 30, 100, 30, 30, and 4 kg/ha of N, P_2O_5 , K_2O , S, and Zn, respectively, for intercropping plots in the form of urea, triple super phosphate, muriate of potash, gypsum, and boric acid. All the fertilizers were incorporated in the soil at the time of final land preparation for sole groundnut plots. But all the fertilizers and one third of urea were applied during final land preparation and remaining two thirds of the urea was top dressed in the sole

carrot and intercropped plots in two installments at 25 and 45 DAE. The groundnut variety BARI Chinabadam-6 and carrot variety Pusha Kashore were used for the experiment. Seeds @ 110 kg/ha of groundnut and 2.5 kg/ha were sown on 25-11-2004 and 20-11-2005, respectively. Spacing of sole groundnut and sole carrot were 40 cm x 15 cm and 30 cm x 10 cm, respectively. Two irrigations were applied at 25 and 50 days after emergence (DAE) and other intercultural operations were done as per requirement. At maturity, ten randomly selected plants of carrot and groundnut were uprooted from each plot for post harvest data collection. Data were collected on plant height, number of branches/plant, number of pods/plant, 1000-seed weight, pod yield/plant and pod yield/ha for groundnut; and plant height, root length, root diameter and yield for carrot. Crops were harvested as whole plot basis and yields were converted to t/ha. Collected data were statistically analysed separately compared by using Least Significant Difference (LSD) test (Steel & Torrie, 1960) and land equivalent ratio (LER) values were computed from the yield data of the crops (Shaner *et al.*, 1982).

$$\text{LER} = \frac{\text{Intercropped yield of groundnut}}{\text{Sole crop yield of groundnut}} + \frac{\text{Sole crop yield of groundnut}}{\text{Sole crop yield of carrot}}$$

Economic analyses have been presented in Table 4. Yield of individual crop was converted into groundnut equivalent yield (GEY) on the basis of the prevailing market price of the products.

$$\text{GEY} = \text{Yield of intercrop groundnut} + \frac{\text{Yield of intercrop carrot} \times \text{price of carrot}}{\text{Price of groundnut}}$$

Results and Discussion

Yield and yield attributes of groundnut

Yield and yield attributes of groundnut as influenced by different intercropping treatments are presented in Table 1. Plant height, number of pods/plant, pod yield/plant and pod yield/ha were significantly affected when grown in different arrangements with carrot but number of branches/plant and 1000-seed weight were non-significant in both the years. The maximum plant height and number of branches/plant were recorded from three rows of groundnut alternated with two rows of carrot treatment. Higher number of pods and pod yields/plant were obtained from the sole plot of groundnut (T₁) followed by T₃ & T₆. The maximum pod yield (2.01 and 2.8 t/ha) were obtained from the plot of sole groundnut in both the years (Table 1). The highest pod yield of groundnut from sole plot might be due to higher number of pods/plant and pod yield/plant. The highest pod yield from the sole plot also reported by Hashem and Monoruzzaman (1986), Shindi *et al.* (1989), Senthivel *et al.* (1989) Mondal *et al.* (1999), Begum *et al.* (2000) and Mondal *et al.* (2004)

Table 1. Pod yield and yield attributes of groundnut as influenced by intercropping groundnut and carrot at ARS, Burirhat, Rangpur during *rabi* Seasons, 2004-05 and 2005-2006.

Treatment	Plant height (cm)		No. of branches/ plant		No. of pods/ plant		1000- seed wt (g)		Pod yield/ plant (g)		Pod yield (t/ha)	
	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr
T ₁ = Sole G.nut	47	42	9.2	8.1	20.00	17.8	541	515	85.00	88.0	2.01	2.8
T ₃ = 2 rows g.nut in between 1 row carrot	38	42	11.4	10.54	19.20	16.6	563	512	75.00	75.3	1.15	2.0
T ₄ = 2 rows g.nut in between 2 rows carrot	40	36	9.5	8.9	15.83	15.9	566	509	70.00	74.3	1.55	1.65
T ₅ = 2 rows g.nut alternate 2 rows carrot	40	41	9.6	9.0	14.26	14.0	548	510	66.66	67.3	1.36	1.45
T ₆ = 3 rows g.nut alternate 3 rows carrot	52	43	12.3	11.2	16.46	16.0	558	500	70.00	77.3	1.28	1.5
CV (%)	10.13	7.07	8.19	7.89	11.90	10.73	7.14	2.20	5.11	4.04	1.62	1.20
LSD (0.05)	6.25	5.47	NS	NS	5.68	3.39	NS	NS	8.01	3.21	0.85	0.75

- G.nut = Groundnut
1 st year = 2004 - 05
2nd year = 2005 - 06

Table 2. Yield and yield attributes of carrot as influenced by intercropping groundnut with carrot during *rabi* seasons of 2004-05 and 2005-06 at ARS, Burirhat, Rangpur.

Treatment	Plant height (cm)		Root length (cm)		Root diameter (cm)		Root wt (g)		Root yield (t/ha)	
	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr
T ₂ = Sole carrot	46	39.5	14.36	12.5	4.6	3.21	114.33	116	22.61	18.82
T ₃ = 2 rows g.nut in between 1 row carrot	44	35.4	13.80	12.1	4.4	3.15	108.33	107	13.88	15.0
T ₄ = 2 rows g.nut in between 2 row carrot	42	37.2	12.86	12.0	4.2	2.63	105.76	95	18.69	16.0
T ₅ = 2 rows g.nut alternate 2 rowss carrot	35	34.2	11.00	12.3	4.0	2.69	85.63	84	15.98	14.1
T ₆ = 3 rows g.nut alternate 3 rows carrot	40	37.5	12.60	10.9	4.1	2.63	83.62	93	12.15	12.5
CV (%)	4.84	7.77	11.11	11.42	7.80	10.42	10.01	13.70	10.33	8.4
LSD (0.05)	1.66	5.34	1.91	1.58	0.41	0.62	20.5	28.1	2.81	2.53

Table 3. Yield, Groundnut Equivalent yield and economic analysis of groundnut and carrot intercropping during rabi season 2004-05 and 2005-06 at ARS, Burirhat, Rangpur.

Treatment	Groundnut equivalent yield (t/ha)		LER		Gross return (Tk./ha)		Cost of cultivation (Tk./ha)		Net return (Tk./ha)		BCR		
	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	1st yr	2nd yr	Average
T ₁ = Sole G.nut	2.01	2.80	1.00	1.00	42,200	56,000	10,600	14,500	31600	41,500	3.98	3.86	3.92
T ₂ = Sole carrot	11.31	12.42	1.00	1.00	1,13,100	1,88,000	25138	30,800	87,962	155200	4.50	6.10	5.3
T ₃ = 2 rows g.nut in between 1 row carrot	9.41	11.00	1.48	1.21	1,88,000	2,20,000	26505	31,370	1,61,495	186630	7.09	7.01	7.05
T ₄ = 2 rows g.nut in between 2 row carrot	10.63	11.10	1.67	1.74	2,12,600	2,48,400	30400	36,720	182200	211680	6.99	6.76	6.87
T ₅ = 2 rows g.nut alternate 2 rows carrot	9.54	9.41	1.59	1.66	1,90,800	2,22,000	27700	35,119	163100	186881	6.89	6.32	6.60
T ₆ = 3 rows g.nut alternate 3 rows carrot	9.03	9.50	1.18	1.18	1,88,600	1,90,000	30800	37,895	149800	152105	5.86	5.01	5.43

Price of non-seed groundnut and carrot

2004-05	2005-06
Groundnut @ Tk.20.00/kg	@ Tk.20.00/kg
Carrot @Tk.10.00/kg	@ Tk.12.00/kg

Yield and yield attributes of carrot

Yield attributes of carrot, such as plant height, root length, root diameter, root weight and root yield/ha were significantly influenced by different treatments in both the years (Table 3). The maximum plant height (46.0 cm & 39.5cm), root length (14.36 cm & 12.50 cm), root diameter (4.60 cm & 3.21 cm), and root weight (114g & 116g) were recorded from sole plots. Maximum yield reduction was recorded from 3 rows of groundnut and carrot; and minimum from 1 row groundnut and 2 rows carrot. Yield was reduced with the increase of carrot rows. The highest root yield/ha (22.61 t/ha & 18.82 t/ha) were found in sole carrot plot. The highest yield from sole carrot plot might be due to higher length of root, diameter of root and root weight. (Table 2). The second highest yield (18.69 t/ha and 16.0 t/ha) were recorded from the plots of two rows of carrot in between two normal rows of groundnut.

Cost Benefit Analysis

Groundnut equivalent yield (GEY):

All the intercropped combinations showed higher groundnut equivalent yield than sole groundnut. Results showed that the highest groundnut equivalent yield 11.31 t/ha & 12.42 t/ha were obtained from sole carrot treatment (T₂) in both the years. Among the intercrops, the groundnut equivalent yield varied from 9.41 to 11.10 t/ha with the highest (10.63 to 11.1) from two rows of carrot in between two normal rows of groundnut. Carrot yield reduced significantly resulting lower GEY in all the intercropping treatments (Table 4).

Land equivalent ratio (LER)

The LER is the total land required by the sole crop to produce as much yield as can be obtained from an intercropping system. All the intercrop combinations showed the higher LER over sole crops. Results showed that the highest LER (1.67 & 1.74) were obtained from two rows of carrot in between two normal rows of groundnut (Table 4). The LER value of 1.67 & 1.74 indicated that by intercropping groundnut with carrot, the productivity of groundnut could be increased upto 67 and 74% over the sole groundnut. It also indicates that by intercropping groundnut with carrot, a farmer could produce 1.55 and 1.65 t/ha groundnut and 18.69 and 16.0 t/ha carrot from one hectare of land instead of growing them separately in 1.67 and 1.74 hectares of land to obtained the same yield. These results are in conformity with the findings of Quayyum *et al.* (1987), Hashem *et al.* (1990) and Hossain and Bari, (1996).

Cost Benefit Analysis

An analysis on cost and return of intercropping groundnut with carrot has been given in Table 4. All the intercropping systems showed higher gross and net return than either groundnut & carrot grown as sole crop. The highest gross return (Tk.212600 & Tk.248400/ha) and net return (Tk.182200 & Tk.211680/ha) were recorded from 2 rows carrot in between 2 rows of groundnut(T₃) but maximum BCR (7.09 & 7.01) were obtained from the treatment with one row of carrot in between two normal rows of groundnut in both the years (Table 4). Among the intercropped combinations, higher gross return were recorded from the treatment T₄ but it was showed lower BCR than T₃ treatment due to higher cost of cultivation. Similar economic advantages of intercropping have also been reported by Hashem *et al.* (1990) and Hossain and Bari (1996) and Khaliq *et al.* (1997).

Significant results showed that groundnut grown as intercrop with carrot is more profitable than grown groundnut alone. The results also suggest the possibility of obtaining a reasonable good yield and profitable economic return from intercropping groundnut with carrot having the row arrangement of one row of carrot in between two normal rows of groundnut.

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